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NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON  
NATIONAL DAM SAFETY PROGRAM, POMPTON DAM (NJ00782), PASSAIC RIV--ETC(U)  
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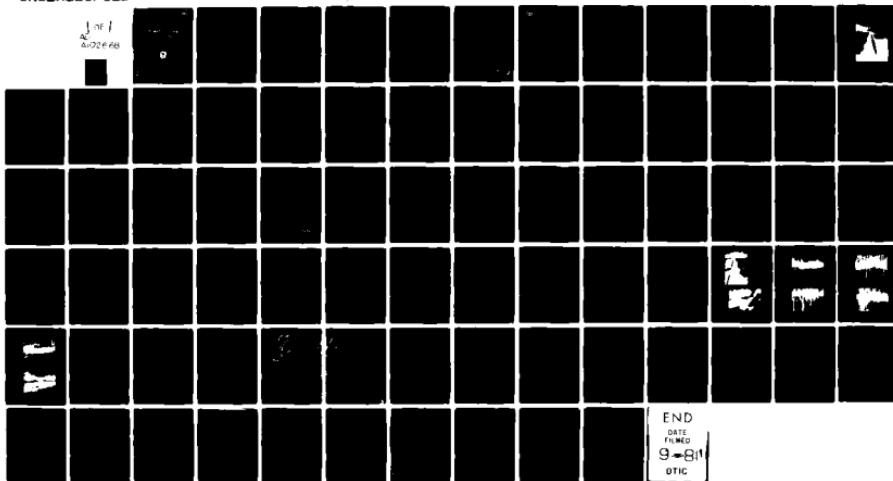
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RAMAPO RIVER, PASSAIC COUNTY  
NEW JERSEY

POMPTON DAM  
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PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM



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Philadelphia District  
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

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PASSAIC RIVER BASIN  
RAMAPO RIVER, PASSAIC COUNTY  
NEW JERSEY

POMPTON DAM

NJ00782

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

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DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
PHILADELPHIA, PENNSYLVANIA 19106

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DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO  
NAPEN-N

26 Jun 1971

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Pompton Dam in Passaic County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Pompton Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 57 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within twelve months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway's adequacy should be initiated.

b. Within twelve months from the date of approval of this report the owner should engage a qualified professional consultant to:

(1) Consider providing low-level outlet facilities to drawdown the reservoir.

(2) Conduct a complete topographic survey of the dam and surrounding area in order to develop a detailed plan and several cross-sections of the dam to form a coherent as-built set.

NAPEN-N

Honorable Brendan T. Byrne

c. Within twelve months from the date of approval of this report, the owner should repair all spalled and deteriorated concrete on the wingwalls and spillway.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

e. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within three months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Roe of the Eighth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



ROGER L. BALDWIN  
Lieutenant Colonel, Corps of Engineers  
Commander and District Engineer

1 Incl  
As stated

Copies furnished:  
Mr. Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief  
Bureau of Flood Plain Regulation  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029

POMPTON DAM (NJ00/82)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 9 January by Harris - ECI Associates, under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Pompton Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 57 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within twelve months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway's adequacy should be initiated.

b. Within twelve months from the date of approval of this report the owner should engage a qualified professional consultant to:

(1) Consider providing low-level outlet facilities to drawdown the reservoir.

(2) Conduct a complete topographic survey of the dam and surrounding area in order to develop a detailed plan and several cross-sections of the dam to form a coherent as-built set.

c. Within twelve months from the date of approval of this report, the owner should repair all spalled and deteriorated concrete on the wingwalls and spillway.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

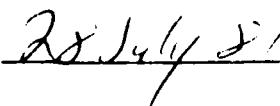
e. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within three months from the date of approval of this report.

APPROVED:

  
ROGER L. BALDWIN

Lieutenant Colonel, Corps of Engineers  
Commander and District Engineer

DATE:

  
28 Jan 82

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name: Pompton Dam, I.D. NJ 00782  
State Located: New Jersey  
County Located: Passaic County  
Stream: Ramapo River  
River Basin: Passaic River  
Date of Inspection: January 9, 1981

Assessment of General Conditions

Pompton Dam is a concrete gravity dam with earthen dikes on each side along the river banks and a concrete overflow weir across the entire river. The overall condition of the dam is good. The downstream channel is well defined and in good condition. There is no low-level outlet for the dam. The hazard potential is rated as "high".

Pompton Dam is considered inadequate in view of its lack of spillway capacity to pass the SDF (1/2 PMF) without overtopping the dam. The spillway is capable of passing a flood equal to 28.0 percent of the PMF, (56.0 percent of the 1/2 PMF), and is assessed as "inadequate".

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory. The following actions are recommended along with a timetable for their completion. All recommended actions should be conducted under the supervision of an Engineer who is experienced in the design, construction and inspection of dams.

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. Based on the results of these studies, remedial measures should be instituted. This should include the installation of a tailwater gage.
2. Repair all spalled and deteriorated concrete on the wingwalls and spillway within twelve months.
3. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

Furthermore, while of a less urgent nature, the following additional actions are recommended and should be carried out within twelve months.

1. Consider providing low-level outlet facilities to drawdown the reservoir.
2. The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.
3. Conduct a complete topographic survey of the dam and surrounding area in order to develop a detailed plan and several cross-sections of the dam to form a coherent as-built set.



John P. Talerico, P.E.  
HARRIS-ECI ASSOCIATES



Photo taken January 9, 1981

P O M P T O N   D A M

View of dam looking towards the left wingwall.

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

POMPTON DAM, I.D. NJ 00782

SECTION 1

1. PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn, is contracted to the Philadelphia District of the Corps of Engineers, and was carried out by the engineering firm of Harris-ECI Associates, Woodbridge, New Jersey.

b. Purpose of Inspection

The visual inspection of Pompton Dam was made on January 9, 1981. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam, embankment and its appurtenant structures.

c. Scope of Report

The report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

Pompton Dam is a concrete gravity dam across the river with earthen dikes on each side along the banks. The dam has a height of 22.2 feet and an overall length, including the dikes, of approximately 1,940 feet. The spillway is a concrete overflow weir which runs the entire length of the dam and is 270 feet long. There is a concrete wingwall at the right side of the spillway, which is 124 feet long and 3 feet wide, running perpendicular to the spillway.

On the left side is another wingwall, which is 99 feet long and 3 feet wide, running perpendicular to the spillway. The tops of both wingwalls are 8.5 feet above the spillway.

The earthen dike along the left bank is approximately 166 feet long and has a crest width of 22 feet. The dike along the right bank is approximately 1,500 feet long (as scaled from the U.S.G.S. map.) with a crest width varying from 15 feet at the wingwall to 10 feet upstream. The top of the left dike is approximately 7.5 feet above the spillway and the right dike approximately 7.2 feet above the spillway. The upstream and downstream slopes of both dikes are approximately 2H:1V. The upstream and downstream toe of slope elevations of both dikes are approximately the same as that of the spillway crest.

The flow from the spillway discharges directly into the Ramapo River. The river continues in a southeastward direction for approximately 1,000 feet where it joins the Pequannock River. The two rivers then become the Pompton River which continues to flow southward crossing under Jackson Avenue-Pompton Plains Cross Road approximately 2,000 feet downstream and Route 23 approximately 2 miles downstream from the spillway.

A generalized description of the soil conditions is contained in Report No. 3, Passaic County, Engineering Soil Survey of New Jersey, by Rutgers University. The report, dated 1951, describes the soil as recent alluvium because the soil, which is composed of non-residual materials, is still subject to alluvial deposition and/or erosion. The underlying bedrock is usually more than 10 to 20 feet deep and is described by Geologic Overlay Sheet 23 as a Brunswick Formation.

b. Location

Pompton Dam is located on the Ramapo River in the Township of Wayne, Passaic County, New Jersey. It is accessible from Route 23 at the Pompton Plains traffic circle by way of Jackson Avenue-Pompton Plains Cross Road.

c. Size Classification

According to the Recommended Guidelines for Safety Inspection of Dams by the U.S. Department of the Army, Office of the Chief Engineers, the dam is classified in the dam size category as being "small", since its storage volume of 949 acre-feet is less than 1,000 acre-feet. The dam is also classified as "small" because its height of 22.2 feet is less than 40 feet. The overall size classification of Pompton Dam is "small".

d. Hazard Classification

A hazard potential classification of "high" has been assigned to the dam on the basis that a hypothetical failure would result in excessive damage to a shopping center located along the right bank of the channel, just downstream of Jackson Avenue-Pompton Plains Cross Road approximately 2,000 feet from the dam. Therefore the possibility exists of the loss of more than a few lives in the event of dam failure.

e. Ownership

Pompton Dam is owned by:

The State of New Jersey  
Division of Parks & Forestry  
Labor & Industry Bldg. Room 808  
John Fitch Plaza  
Trenton, NJ 08625

Attention: Mr. Al Guido  
Deputy Director  
(609)292-2772

f. Purpose

Pompton Dam is presently used for recreational purposes.

g. Design and Construction History

Pompton Dam was constructed in 1928, to replace the old Morris Canal Dam which supplied water to the old Morris Canal. In 1940 some reconstruction took place to allow for the dam's present purpose as well as its use as a gaging station. There is no data, or plans available showing either the original construction or the reconstruction.

The date of construction of the earthen dikes is unknown but when the dam was constructed in 1928, the wingwalls were built to their present elevation. and as there is no record or mentioning of work being done on the dikes, it is assumed that they were part of the old Morris Canal Dam system.

h. Normal Operating Procedures

The discharge from Pompton Dam is unregulated and is allowed to naturally balance the inflow from the Ramapo River. There are no low-level outlets for the dam.

1.3 Pertinent Data

a. Drainage Area

161.1 sq. mi.

b. Discharge at Dam Site

Ungated spillway capacity at elevation of top of dam: 16,692 cfs (182.7 NGVD)

Total spillway capacity at maximum pool elevation (SDF): 28,913 cfs (184.64 NGVD)

c. Elevation (Feet above NGVD)

Top of dam: 182.7

Maximum pool design surcharge (SDF): 184.64

Recreation pool: 175.5

Spillway crest: 175.5

Streambed at centerline of dam: 160.5 (Estimated)

Maximum tailwater: 164 (Estimated)

d. Reservoir

Length of maximum pool: 3,800 ft. (Estimated)

Length of recreation pool: 2,200 ft. (Estimated)

e. Storage (acre-feet)

Spillway Crest: 58

Top of dam: 949

Maximum pool (SDF): 1,375

f. Reservoir Surface (acres)

Top of dam: 190 (Estimated)

Maximum pool (SDF): 210 (Estimated)

Recreation pool: 11.5 (175.5 NGVD)

Spillway crest: 11.5 (175.5 NGVD)

g. Dam

Type: Concrete gravity.

Length: 1,940 ft. (Includes Earthen Dikes)

Height: 22.2 ft.

Top width: 22 ft. - Left Dike  
10 ft. to 15 ft. - Right Dike

Side slopes - Upstream:  
- Downstream: 2H:1V  
2H:1V

Zoning: Unknown

Impervious core: Unknown

Cutoff: Unknown

Grout curtain: Unknown

h. Diversion and Regulating Tunnel

N/A

i. Spillway

Type: Concrete overflow weir.

Length of weir: 270 ft.

Crest elevation: 175.5 NGVD

Gates: None

U/S Channel: Ramapo River

D/S Channel: Ramapo River

j. Regulating Outlets

Low level outlet: None

Controls: None

Emergency gate: None

Outlet: None

## SECTION 2

### 2. ENGINEERING DATA

#### 2.1 Design

There are no available drawings or design computations for the Pompton Dam. No data from soil borings, soil tests, or other geotechnical data is available. No cross-sections suitable for assessing the stability are available. There is a reference data sheet available dated March 20, 1930, giving dimensions of the dam in the Trenton office files of the NJ Department of Environmental Protection (NJ-DEP).

#### 2.2 Construction

Data is not available concerning the as-built construction of the dam. No data exists on the construction methods, borrow sources, or other data pertinent to the construction of the dam.

#### 2.3 Operation

Formal operation records are not kept for the dam. The river is allowed to operate naturally without regulation.

#### 2.4 Evaluation

##### a. Availability

The availability of engineering data is very poor.

##### b. Adequacy

The engineering data obtained in the field was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform a stability analysis, but preliminary evaluation could be made based on visual observations.

##### c. Validity

Information contained in the dam reference data sheet and checked by limited field measurements appears valid.

## SECTION 3

### 3. VISUAL INSPECTION

#### 3.1 Findings

##### a. General

The visual inspection of Pompton Dam revealed the dam and earthen dikes to be in good condition but in need of minor repairs. The river level was above the spillway crest at the time of inspection.

##### b. Dam

The earthen dikes appeared to be sound and did not show any signs of instability. The horizontal and vertical alignments of the left dike are good. The alignments along the right dike are irregular. There are trees and brush growing along both slopes of the left dike and both slopes and crest of the right dike. The upstream and downstream toe of slopes for both dikes are approximately at the same elevation as the spillway crest therefore under normal flow they do not impound any water.

##### c. Appurtenant Structures

###### 1. Spillways

The concrete overflow spillway appears sound. There was spalling along the top and downstream faces of the dam. No misalignment of the dam in the horizontal or vertical planes was evident.

###### 2. Wingwalls

There is a 3 foot wide wingwall at the right and at the left side of the dam. The right wingwall has an overall length of 124 feet while the overall length of the left wingwall is 99 feet. The tops of both wingwalls are horizontal and 8.5 feet above the crest of the dam and approximately 1 foot plus/minus above the dikes. Both wingwalls slope downward at a rate of approximately 1H:1V for a distance of about 27 feet. At the bottom of the sloped section is a 12 foot horizontal section. At the time of inspection both walls were in good condition. Minor spalling was observed along the face of the right wingwall, with some surface cracks appearing on the top of the wall. The downstream end of the right wall was heavily spalled and deteriorated exposing some reinforcing bars along the top. The left wingwall was in a condition similar to the first. It had minor spalling and surface cracks along the face and top, and heavy spalling and deterioration at the downstream end exposing reinforcing bars. No misalignment of the walls in the horizontal or vertical planes was evident.

d. Reservoir Area

The slope along the left bank beyond the dike is fairly flat with homes along the upper end of the reservoir. There is a large island immediately upstream of the spillway in the middle of the river channel.

e. Downstream Channel

The discharge from the spillway passes into a flat and wide channel. The slopes on both sides are flat and wooded. The first building downstream approximately 1,800 feet from the dam is a batching plant on the left bank above the flood plain. Just downstream from the batching plant the river flows under Jackson Avenue-Pompton Plains Cross Road and along a shopping center on the right and then under Route 23 approximately 2 miles downstream of the dam.

## SECTION 4

### 4. OPERATIONAL PROCEDURES

#### 4.1 Procedures

The Pompton Dam is used to impound water for recreational purposes. The upstream level is maintained through the unregulated flow over the spillway.

#### 4.2 Maintenance of the Dam

There is no regular inspection and maintenance program for the dam and appurtenant structures. The State of New Jersey, Division of Parks and Forestry is responsible for the maintenance of the dam.

#### 4.3 Maintenance of Operating Facilities

There are no low-level outlet facilities for the dam.

#### 4.4 Evaluation

The present operational and maintenance procedures are fair with the dam being maintained in a serviceable condition.

## SECTION 5

### 5. HYDRAULIC/HYDROLOGIC

#### 5.1 Evaluation of Features

##### a. Design

The drainage area above Pompton Dam is approximately 161.1 square miles. A drainage map of the watershed of the dam site is presented on Plate 1, Appendix D.

The topography within the basin is generally moderate to steeply sloped. Elevations range from approximately 1,370 feet above NGVD at the north end of the watershed to about 180 feet at the dam site. Land use patterns within the watershed are mostly woodland with some residential development around the lake areas.

The evaluation of the hydraulic and hydrologic features of the dam was based on criteria set forth in the Corps guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for the Dam is the 1/2 PMF.

The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation using Hydrometeorological Report No. 33 with standard reduction factors. A 6 hour unit hydrograph was used to develop the inflow hydrograph at the lake, with the aid of HEC-1-DB program.

Initial and constant infiltration loss rates were applied to the Probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the PMF and various ratios of PMF utilizing program HEC-1-DB.

The SDF peak outflow calculated for the dam is 28,913 cfs. This value is derived from the half PMF, and results in overtopping of the dam, assuming that the lake was originally at the spillway crest elevation.

The stage-outflow relation for the spillway was determined from the geometry of the spillway and dam, utilizing HEC-1-Dam Safety Version Program.

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC-1-DB program. The reservoir surface areas at various elevations were measured by planimeter from a U.S.G.S Quadrangle topographic map. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based on the assumption that the dam remains intact during routing. The spillway rating curve is presented in the Hydrologic Computation, Appendix D.

A breach analysis indicates that the stage of the stream where it crosses Jackson Avenue-Pompton Plains Cross Road is 1.1 feet higher, due to dam failure from overtopping at 0.3 PMF than it would be without failure at 0.3 PMF. This is not likely to jeopardize the development downstream significantly more than without failure. The discharge facility is thus rated "inadequate".

Drawdown calculations could not be done since there is no low-level outlet for the dam.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site.

c. Visual Observation

The downstream channel of the Ramapo River is fairly wide with relatively flat, shallow and wooded slopes. Approximately 1,000 feet downstream the river joins the Pequannock River to form the Pompton River. It then crosses under Jackson Avenue-Pompton River Plains Cross Road 2,000 feet from the dam and Route 23 approximately 2 miles from the spillway. Just downstream of Jackson Avenue-Pompton Plains Cross Road is a shopping center on the right bank.

The side slopes of the reservoir are flat with homes along the left shore, and do not exhibit any signs of instability. The drainage area is wooded and moderately to steeply sloped.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 1.94 feet. Computations indicate that the dam can pass approximately 28.0 percent of the PMF without overtopping the dam crest. Since the 1/2 PMF is the Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the dam is assessed as "inadequate".

## SECTION 6

### 6. STRUCTURAL STABILITY

#### 6.1 Evaluation of Structural Stability

##### a. Visual Observations

At the time of inspection Pompton Dam did not exhibit any visible signs of distress. There was no evidence of tilting, misalignment or movement of the foundations. The vertical and horizontal alignment of the crest was good. There was some spalling along the downstream face of the dam. The downstream end of both wingwalls is deteriorated exposing the reinforcing steel.

##### b. Design and Construction Data

No design computations relating to stability were uncovered during the report preparation phase. No foundation soil parameters are available for carrying out a conventional stability analysis on the dam.

##### c. Operating Records

No operating records are available relating to the stability of the dam.

##### d. Post - Construction Changes

In 1940 the dam underwent some reconstruction. There are no plans or data available describing the type or extent of the reconstruction.

##### e. Static Stability

A static stability analysis was not performed for Pompton Dam because the lack of data on which to base assumptions of foundation material properties and actual dimensions might produce misleading results. Based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

##### f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist, and based on the findings of the visual inspection, the preliminary assessment of the static and seismic stabilities is that they are satisfactory.

## SECTION 7

### 7. ASSESSMENT/REMEDIAL MEASURES

#### 7.1 Dam Assessment

##### a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report.

Pompton Dam is inadequate because the dam does not have spillway capacity to pass the SDF, the 1/2 PMF, without overtopping. Overtopping of the dam carries with it the danger of a possible failure of the dam. The present spillway capacity of the dam is approximately 28.0 percent of the PMF.

No definitive statement pertaining to the safety of the dam can be made without acquisition of foundation material engineering properties, but based on the findings of the visual inspection, preliminary assessment of the static stability is that it is satisfactory.

##### b. Adequacy of Information

The information uncovered was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform even an approximate computation of the stability of the dam. A preliminary assessment of the dam could be made by visual observation only.

##### c. Urgency

The remedial measures and recommended actions along with a timetable for their completion are detailed below. All recommended action should be conducted under the supervision of an engineer who is experienced in the design, construction and inspection of dams.

#### 7.2 Remedial Measures

##### a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. 1. Increase the embankment height of the dam thus permitting a higher discharge to pass.
2. Lower the spillway crest elevation.

3. Increase the effective spillway crest length.
4. A combination of any of the above alternatives.

b. Recommendations

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages. The ability of the dam to withstand overtopping should also be studied.
2. Repair all spalled and deteriorated concrete on the wingwalls and the spillway within twelve months.

The following additional actions are recommended:

1. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.
2. Conduct a complete topographic survey of the dam and surrounding area, in order to develop a detailed plan and several cross-sections of the dam to form a coherent as-built set.
3. Consider providing low-level outlet drawdown facilities.

c. O & M Procedures

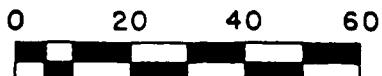
The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

PLATES

POMPTON DAM  
WAYNE TWP.  
PASSAIC CO., N. J.

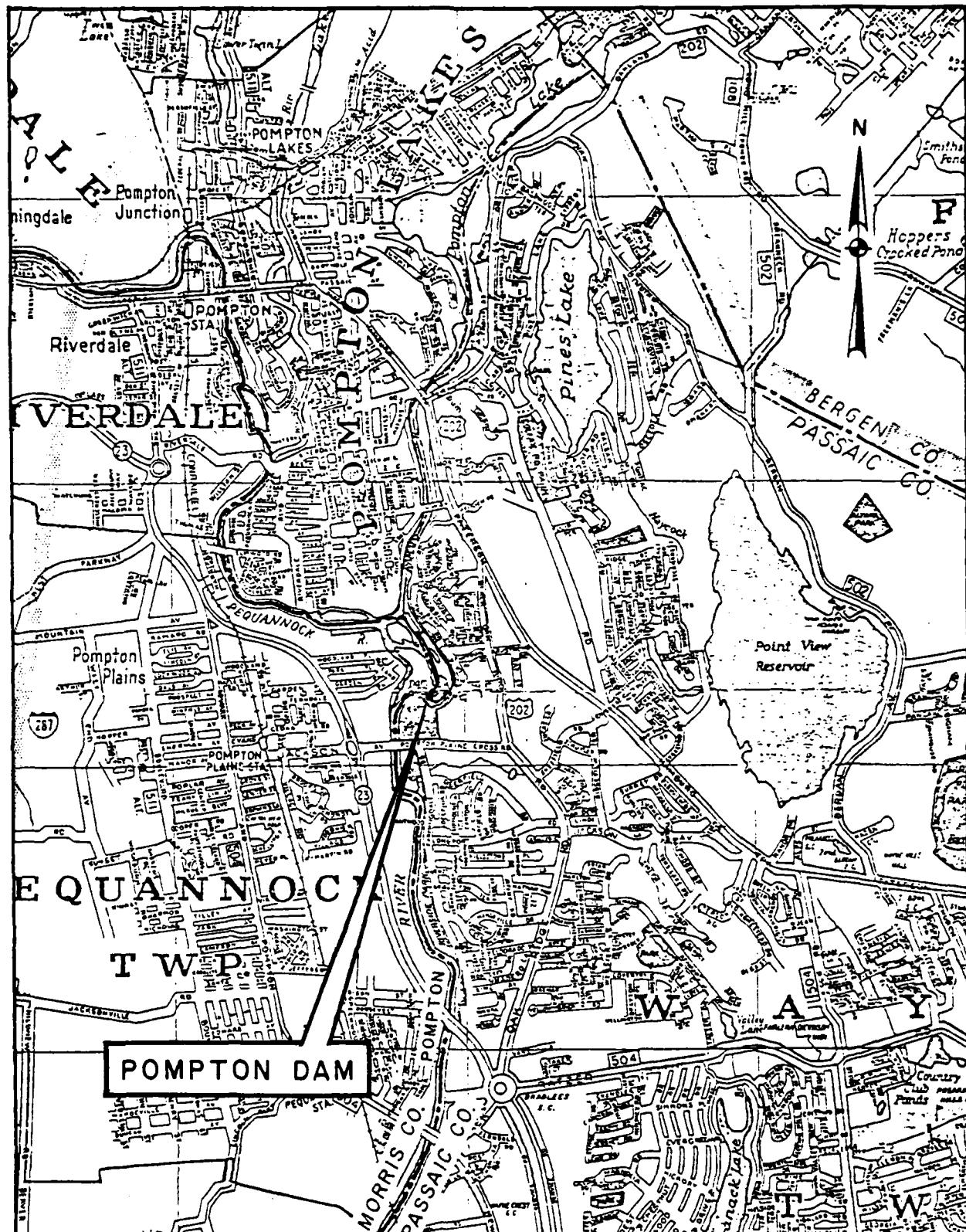


Scale in Miles (Approx.)



KEY MAP

PLATE I

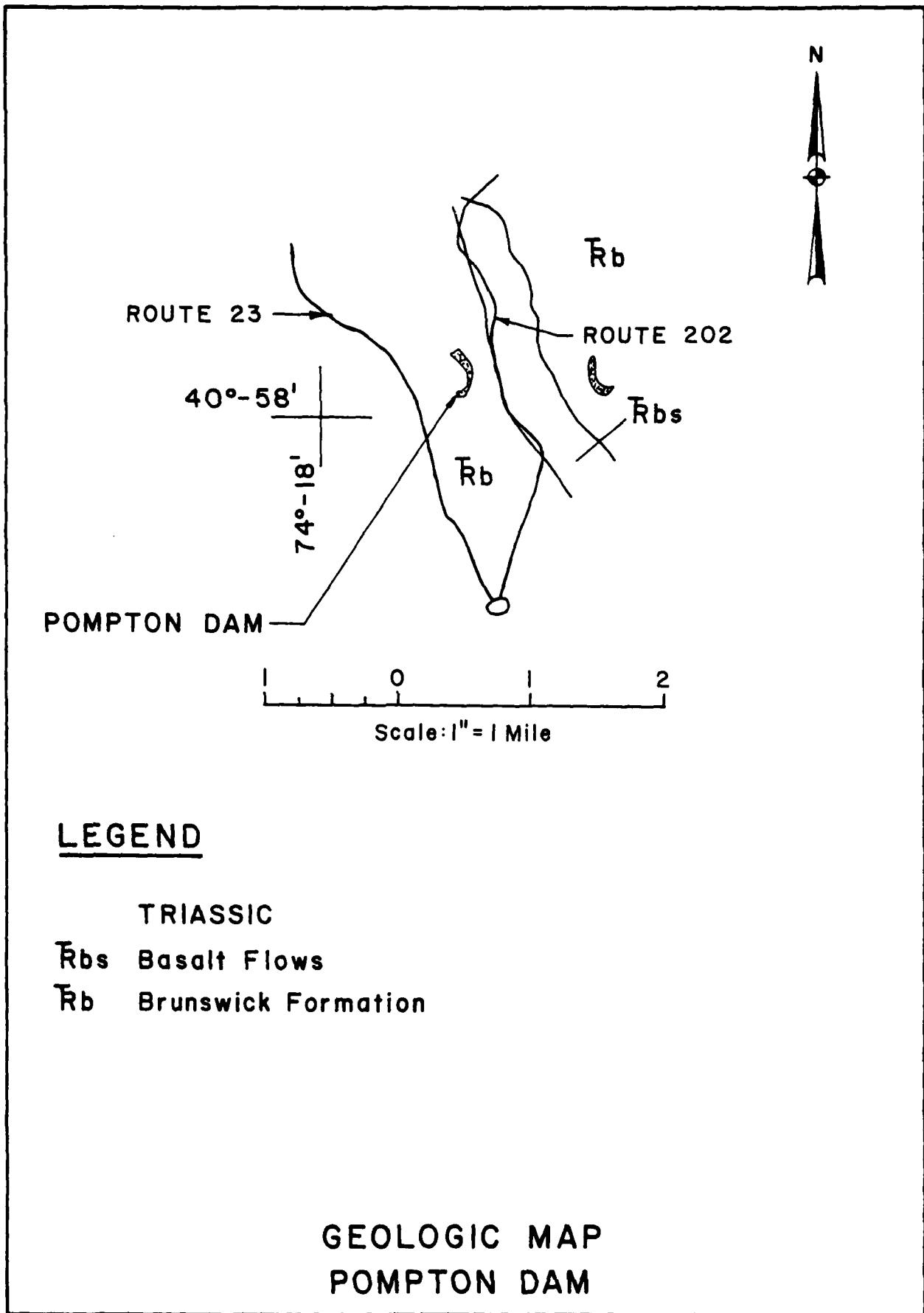


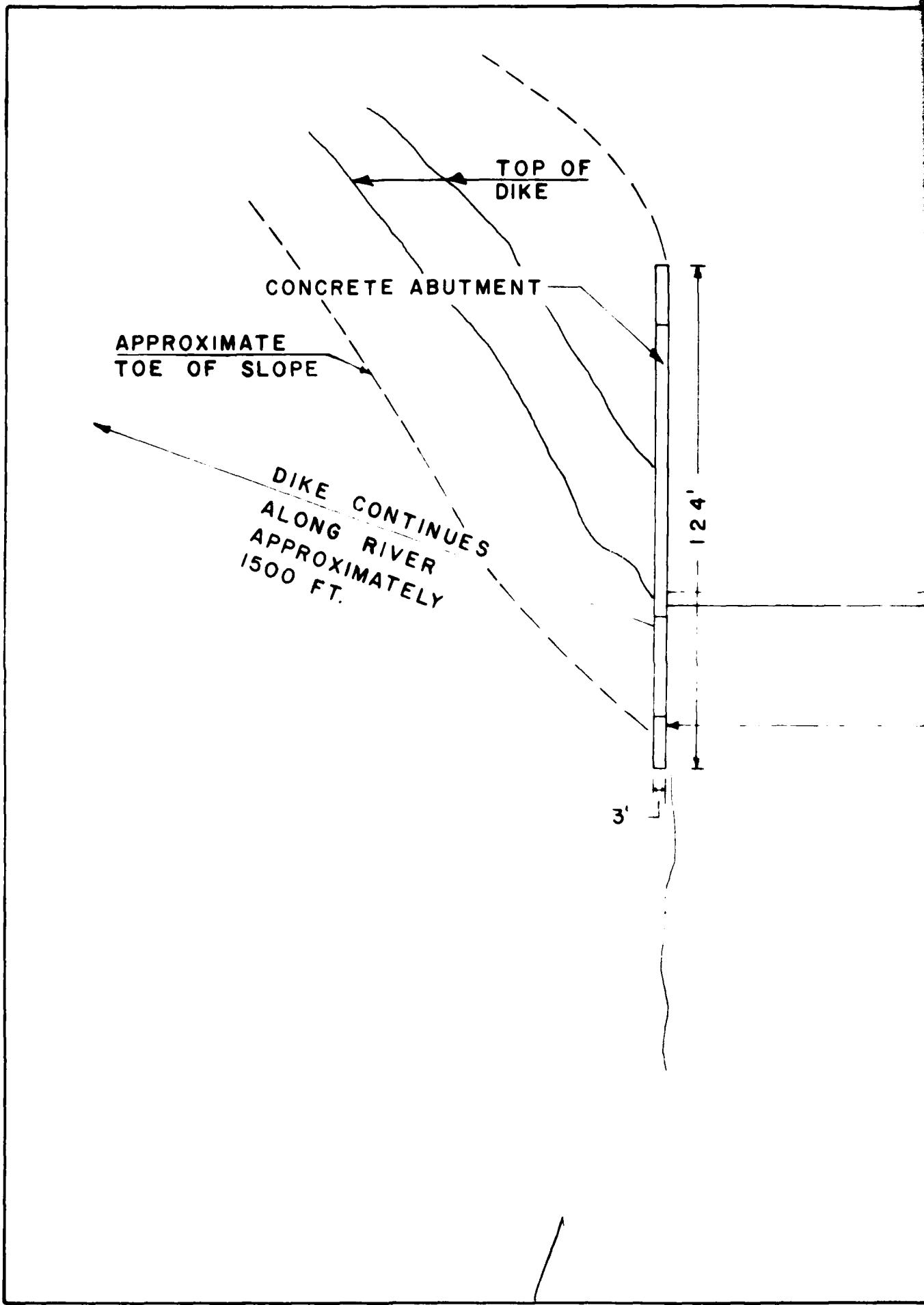
Scale in Feet (Approx.)

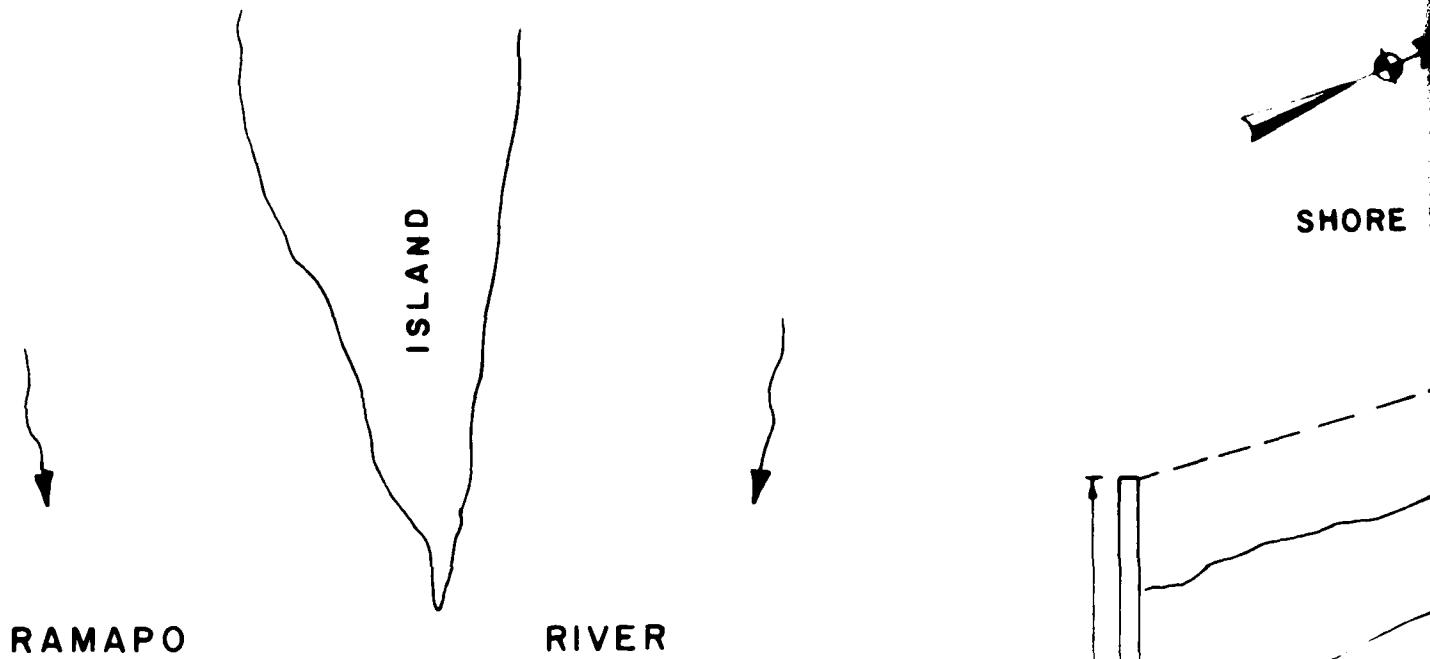
4,000 0 4,000 8,000

VICINITY MAP

PLATE 2

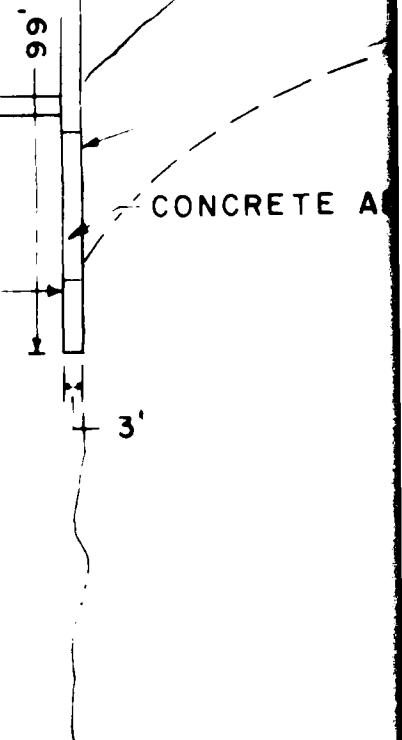




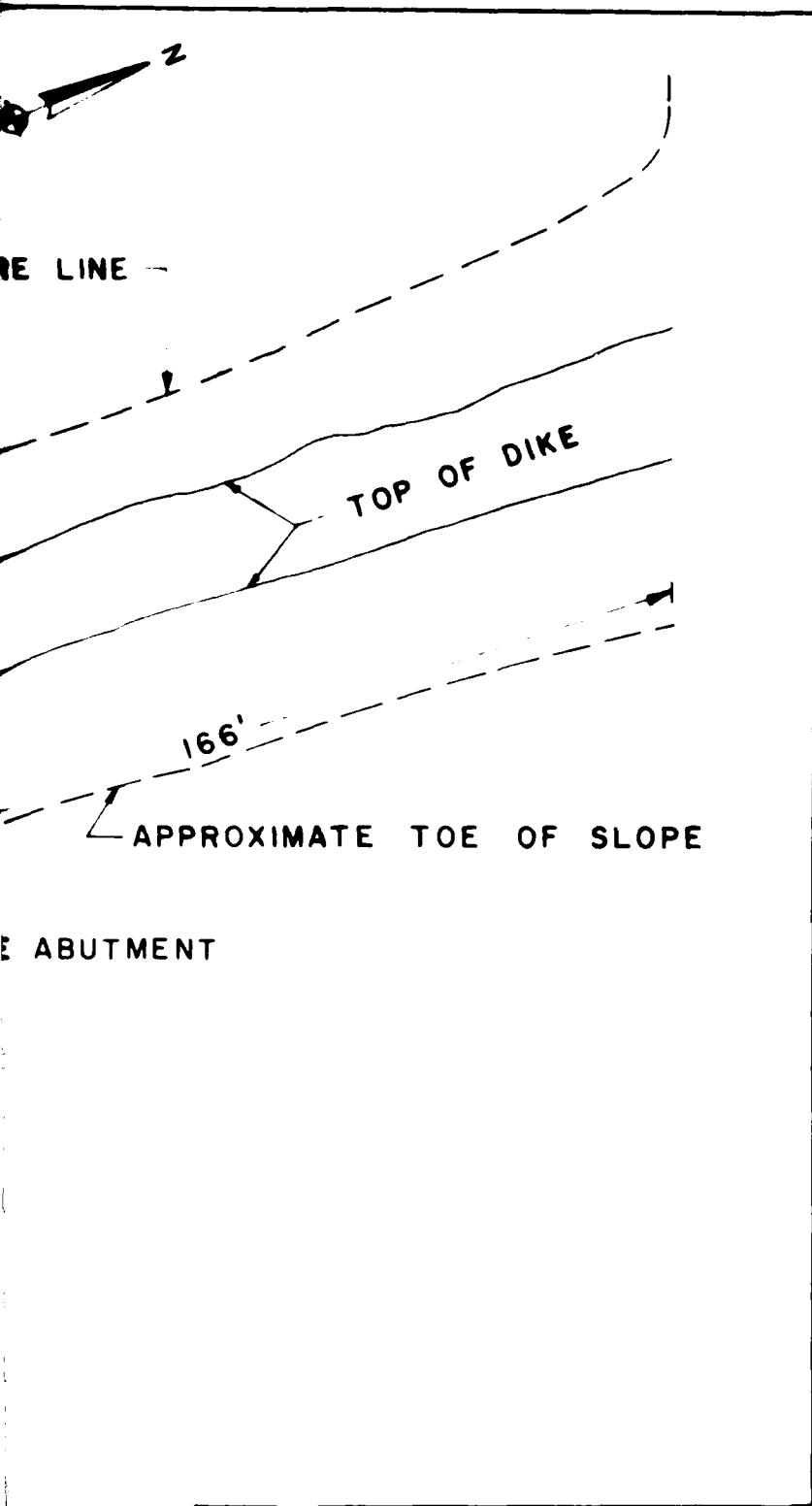


CONCRETE OVERFLOW SPILLWAY

270'  
(MEASURED DISTANCE)



PLAN  
SCALE: 1" = 30'



POMPTON DAM  
WAYNE TOWNSHIP, PASSAIC COUNTY, N.J.

SKETCH OF PLAN  
PREPARED FROM FIELD NOTES TAKEN  
DURING INSPECTION ON JAN. 9, 1981

BY:  
HARRIS-ECI ASSOCIATES  
WOODBRIDGE, N.J.

SCALE: AS SHOWN  
DATE: FEB. 1981  
SHEET: 1 OF 1

PLATE 4

APPENDIX A  
CHECK LIST - VISUAL OBSERVATIONS  
CHECK LIST - ENGINEERING, CONSTRUCTION  
MAINTENANCE DATA

CHECK LIST  
VISUAL INSPECTION  
PHASE 1

Name Dam Pompton Dam County Passaic State New Jersey Coordinators NJ-DEP

Date(s) Inspection January 9, 1981 Weather Cloudy Temperature 15°F

Pool Elevation at Time of Inspection 175.5 NGVD Tailwater at Time of Inspection 163 NGVD

Inspection Personnel:

January 9, 1981

William Birch  
Thomas Moroney  
Joseph Sirianni (Recorder)

OWNER/REPRESENTATIVE:

(Did not attend)

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Dam is an overflow section along its entire length.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Good.	
DRAINS	None.	
WATER PASSAGES	None.	
FOUNDATIONS	Unknown.	2.

## CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Some spalling was observed along the downstream face and along the crest of the dam. Both wingwalls have minor spalling and surface cracks with the downstream ends exhibiting heavy spalling and deterioration, exposing reinforcing bars.	Repair cracks and spalling. Repair downstream ends of wingwalls and provide proper cover for reinforcing bars.
STRUCTURAL CRACKING	None	
VERTICAL & HORIZONTAL ALIGNMENT	Good	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	Good	

## EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
		EMBANKMENT
SURFACE CRACKS	None visible	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None visible	
SLoughing or Erosion of Embankment and Abutment Slopes	Very irregular	
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	Horizontal and vertical alignments are good for the left earthen dike and irregular for the right earthen dike.	
RIPRAP FAILURES	None.	

## EMBANKMENT

## VISUAL EXAMINATION OF

## OBSERVATIONS

## REMARKS AND RECOMMENDATIONS

## EARTH EMBANKMENT

Embankments left and right of spillway appear to be dikes for the retention of flood waters. At the time of inspection the water level appeared to be at the same elevation as the downstream toe. Brush and trees are growing on both slopes and crest of right dike and both slopes of left dike.

## JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM

Good.

## ANY NOTICEABLE SEEPAGE

None.

## STAFF GAGE AND RECORDER

None.

## DRAINS

None.

VISUAL EXAMINATION OF CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
N/A - There is no low-level outlet for the dam.		Consider providing low-level outlet facilities to drawdown the reservoir.
INTAKE STRUCTURE	None.	
OUTLET STRUCTURE	None.	
OUTLET FACILITIES	None.	
EMERGENCY GATE	None.	6

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	Concrete overflow weir. Some spalling and surface cracks were observed along the downstream face and across the crest.	Repair spalling and cracks.
APPROACH CHANNEL	Ramapo River is the approach channel	
DISCHARGE CHANNEL	Ramapo River is the discharge channel.	
BRIDGE AND PIERS	None.	7

## INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	Water level indicator located on the left end of the dam.	8

## RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Fairly flat . Tree lined near spillway with homes at the upper end of lake.	
SEDIMENTATION	None visible. River covered with ice.	

## DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
Appears good, no debris.		
SLOPES	Moderately flat. Trees on right side with some mounds of dirt on the left.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	There is a batching plant 1,800 feet downstream on the left of the channel above the flood plain. Approximate 2,000 feet from the spillway the channel flow under Jackson Avenue-Pompton Plains Cross Road and by a shopping center on the right side. The channel flows under route 23 about 2 miles from the spillway.	

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None available.
REGIONAL VICINITY MAP	Available - Passaic County Map and U.S.G.S. Quadrangle Sheet for Pompton Plains, NJ
CONSTRUCTION HISTORY	None available.
TYPICAL SECTIONS OF DAM	None available.
HYDROLOGIC/HYDRAULIC DATA	None available.
OUTLETS - PLAN	
	- DETAILS
	- CONSTRAINTS
	- DISCHARGE RATINGS
RAINFALL / RESERVOIR RECORDS	None available.

CHECK LIST  
 ENGINEERING DATA  
 DESIGN, CONSTRUCTION, OPERATION  
 (continued)

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	Available-Geologic Sheet No. 23 for Passaic County and Engineering Soil Survey of New Jersey, Report No. 3 -- Passaic County by Rutgers University (New Brunswick, NJ)
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Unknown
SPILLWAY PLAN - SECTIONS - DETAILS	None available.

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	N/A
MONITORING SYSTEMS	None available.
MODIFICATIONS	None available.
HIGH POOL RECORDS	None available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	Unknown
MAINTENANCE OPERATION RECORDS	None kept.

APPENDIX B

PHOTOGRAPHS

(Photos taken January 9, 1981)

POMPTON DAM



Photo 1 - View of dam looking towards right wingwall



Photo 2 - View of deteriorated concrete and exposed reinforcing steel at downstream face of left wingwall.

POMPTON DAM



Photo 3 - View of river and island looking upstream from left wingwall.



Photo 4 - View of downstream slope of left dike looking towards the dam.

POMPTON DAM



Photo 5 - View of top of right dike looking upstream.  
River is out of view to the right.



Photo 6 - View of downstream slope of right dike looking  
towards the dam.

POMPTON DAM



Photo 7 - View of dam from downstream channel.



Photo 8 - View of dam and downstream channel looking from the left wingwall.

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

Name of Dam: POMPTON DAM

Drainage Area Characteristics: 161.1 square miles

Elevation Top Normal Pool (Storage Capacity): 175.5 NGVD (58 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: 184.64 NGVD (SDF pool: 1,375 acre-feet)

Elevation Top Dam: 182.7 NGVD (949 acre-feet)

SPILLWAY CREST:

a. Elevation 175.5 NGVD

b. Type Concrete overflow weir

c. Width 3 feet

d. Length 270 feet

e. Location Spillover Entire length of dam

f. No. and Type of Gates None

OUTLET WORKS:

a. Type None

b. Location N/A

c. Entrance Inverts N/A

d. Exit Inverts N/A

e. Emergency Draindown Facilities None

HYDROMETEOROLOGICAL GAGES:

a. Type None

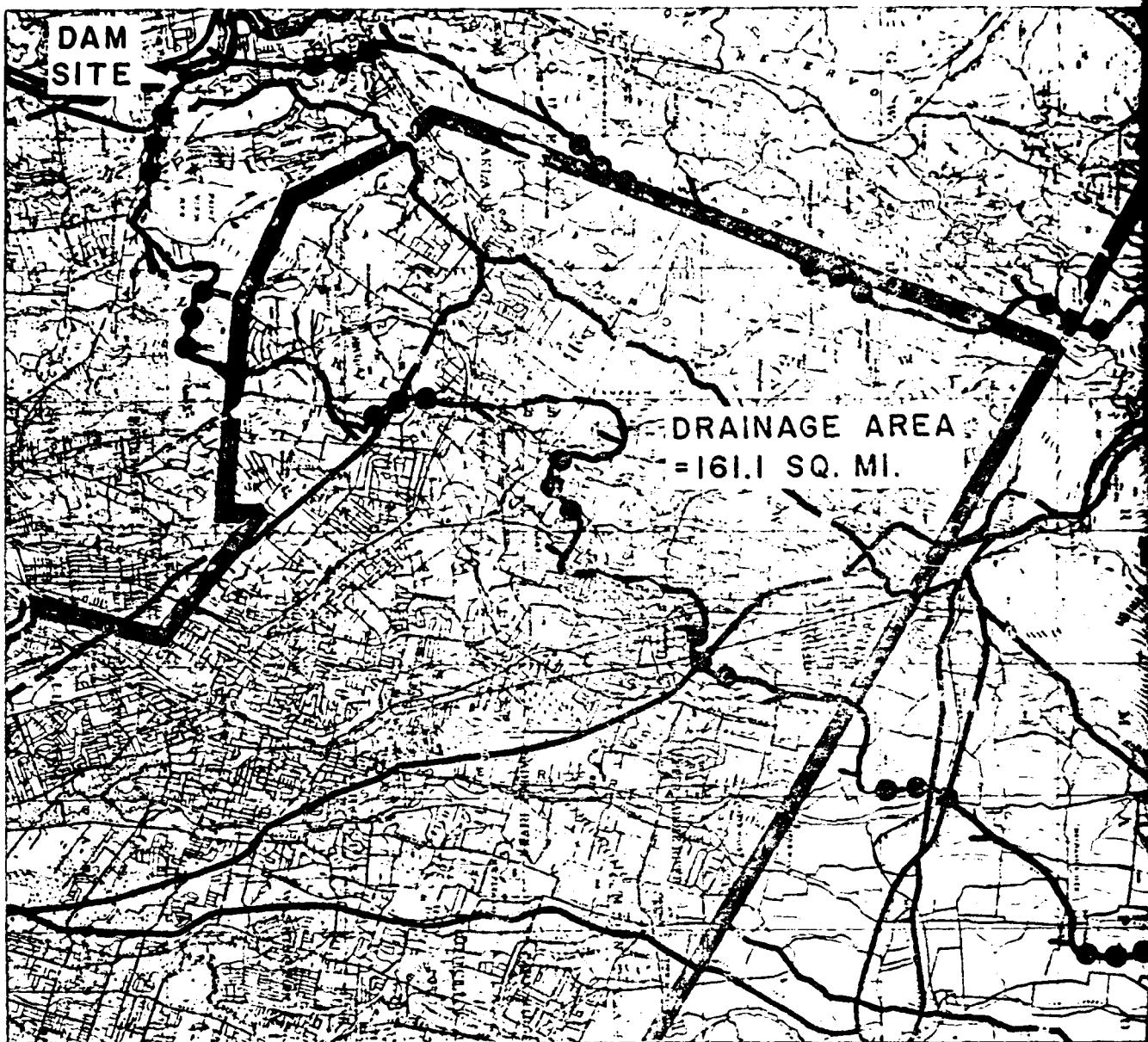
b. Location None

c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: 16,692 cfs at elevation 182.7 NGVD

APPENDIX D

HYDROLOGIC COMPUTATIONS



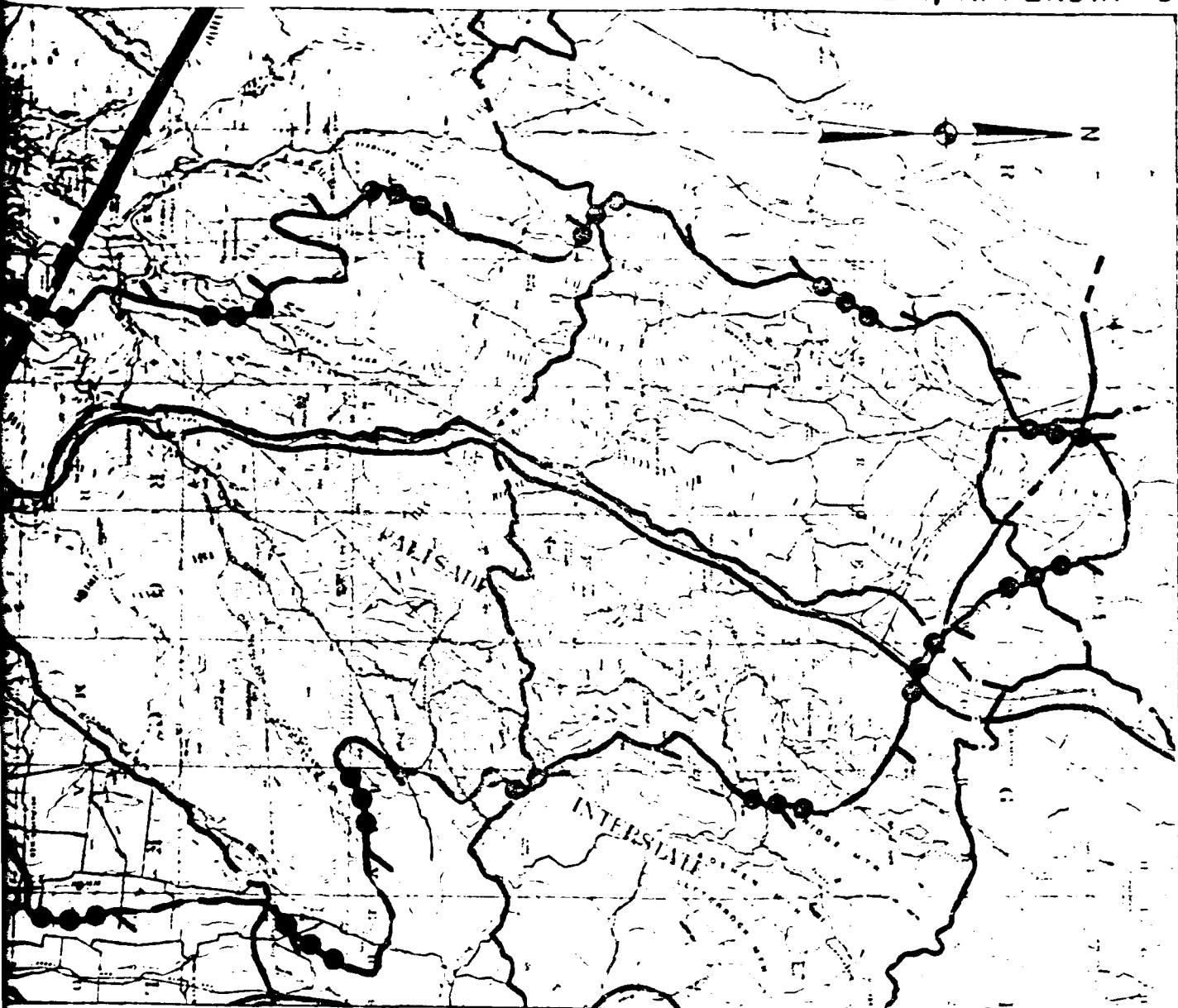
OUTLINE OF  
DRAINAGE AREA

2 0

Scale: 1"

POMPT  
DRAINAGE

PLATE I, APPENDIX D



0 2 4

Scale: 1" = 2 Miles

HAMPTON DAM  
LAKAGE BASIN

Area of Lake at normal pool level  
 $= 16.54 - 2 \text{ islands of total } 5.04$   
 $= 11.5 \text{ AC}$

Height of the Dam = 19.2 (max)

Small Dam, High Hazard

$$S.D.F = \frac{1}{2} PMF$$

### Hydrologic analysis

$$D.A = 161.1 \text{ sq miles}$$

Inflow Hydrograph at reservoir was determined using HEC 1 DB program. Inflow routed through reservoir.

### Reservoir stage area relations

Elevation	Area in Acres
160.5	0
175.5	11.5
180	183.65
200	413.22

Reservoir storage stage relationship was determined by HEC 1 DB program from the Area-Stage relationship.

Determination of PMP

Probable Maximum ppt. (inches) for an area of  
10 square miles and 6 hour duration  
= 26.1"

$$D.A. = 161.1 \text{ sq. miles}$$

$$\text{Zone} = 6$$

The Corps of Engineers recommended that 11.78% reduction to be applied to the report value for a 10 sq miles drainage area in order to provide for the imperfect fit of the storm hydroetal patterns to the shape of the particular basin.

$$P.M.P. = 22.9" \text{ (This reduction is done by the computer in the program)}$$

Depth area duration relationship.

Percentage to be applied to the above 6 hr. PMP

$$6 \text{ hr} = \del{100} \% \quad 76\%$$

$$12 \text{ hr} = \del{100} \% \quad 83\%$$

$$24 \text{ hr} = \del{100} \% \quad 92\%$$

$$48 \text{ hr} = \del{100} \% \quad 110\%$$

$$\text{Initial Infiltration} = 1"$$

$$\text{Constant Infiltration} = 0.1" / \text{hr}$$

### IN FLOW HYDROGRAPH

A 6 hr. Unit hydrograph is developed from a given 12 hour unit hydrograph.

Drainage area = 161.1 sq. miles.

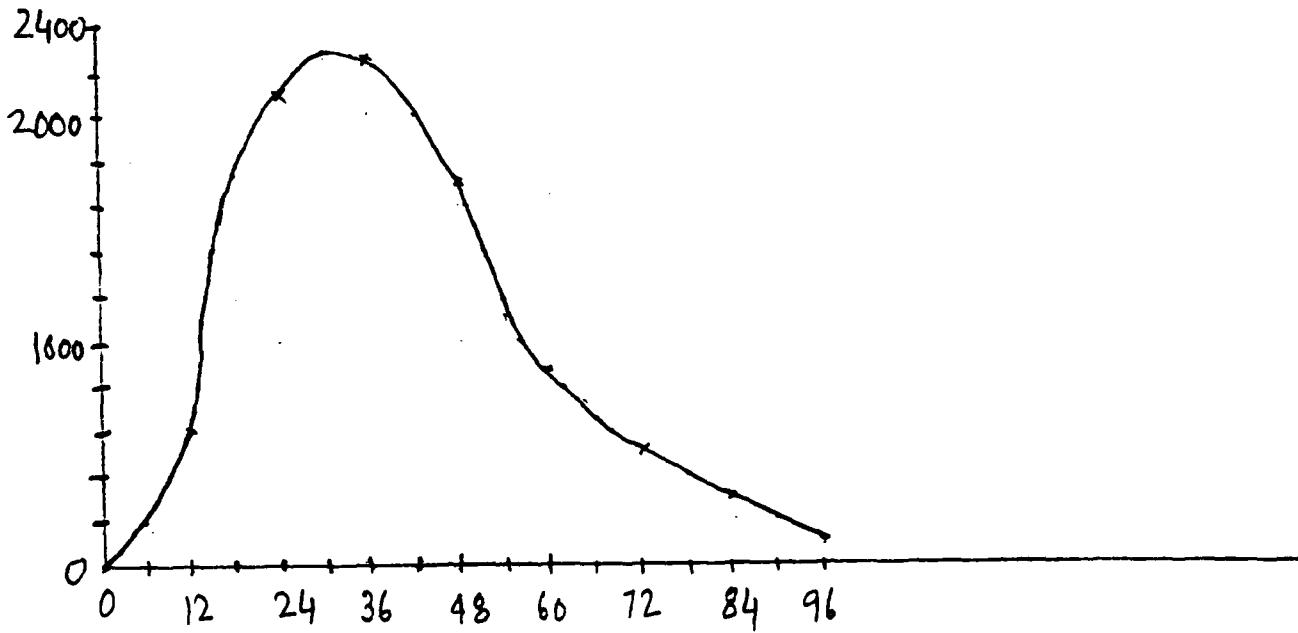
U.H.G. ordinates for the end of period are as follows:-

600, 2100, 2239, 1700, 850, 500, 300.

Rule:- Determine S curve =  $S_1$   
Lag S curve by 6 hrs =  $S_2$

6 hrs U.H.G.  $(S_1 - S_2) \times 2$

Draw the U.H.G.



Unit Hydrograph is tabulated at 6 hr. duration.

Time Hrs	12 Hr U.H.G	S curve addition	S curve ② + ③ ④	Lagged S-curve ④ - ⑤ ⑤	Adjust ④ - ⑤ ⑥	6 Hr U.H.G ⑦ x 2 8
	①	②	③	④	⑥	⑦
0	0		0	0	0	0
6	200		200	0	200	200
12	600	0	600	200	400	400
18	1750	200	1950	600	1350	750
24	2100	600	2700	1950	750	1500
30	2250	1950	4200	2700	1500	2700
36	2239	2700	4939	4200	739	1261
42	2000	4200	6200	4939	1261	1520
48	1700	4939	6639	6200	439	1480
54	1200	6200	7400	6639	761	900
60	850	6639	7789	7400	389	389
66	650	7400	8050	7789	561	780
72	500	7789*	8289	8050	239	520
78	400	8050	8450	8289	161	480
84	300	8289	8589	8450	139	320
		8450				280
		8589				

\* Adjusted

CHECK

1" pft. over 161.1 sq miles

$$= \frac{1}{12} \times 161.1 \times 640 \times 43560 = 3.7427 \times 10^8 \text{ cu ft}$$

$$\text{Vol of U.H.G} = 6 \times 60 \times 60 \times \left[ \frac{0+280}{2} + \text{all other from } 400 \text{ to } 320 \right]$$

$$= 6 \times 60 \times 60 \times [140 + 169.20] = 3.685 \times 10^8 \text{ cu ft}$$

$\approx 0.98$  inch (0.1K)

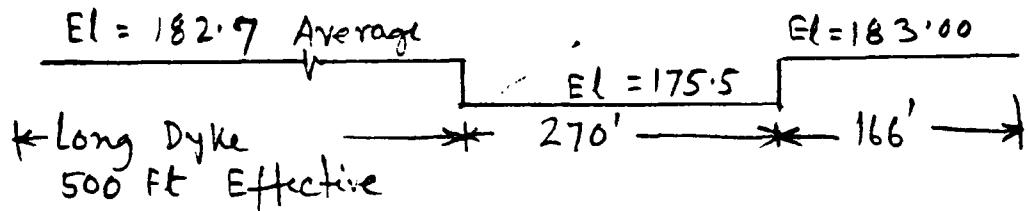
## Inflow Hydrograph

12 hour unit hydrograph is used to develop the 6 hr unit hydrograph. The unit hydrograph ordinates supplied by C.G.E.

Unit hydrograph ordinates for the end of period are as follows:-

600, 2100, 2239, 1700, 850, 500, 300  
(For 12 hr duration)

## Schematic layout of Dam and Spillway



$$\begin{array}{llll}
 \text{Effective length of Spillway} & = L_S = 270' & C = 3.2 \\
 " & " \text{ of Left Dam} & = L_L = 500' & C = 2.7 \\
 " & " \text{ of Right Dam} & = L_R = 166' & C = 2.7
 \end{array}$$

Let. W.S. El = H

$$\begin{aligned}
 Q = & 3.2 \times 270 \times (H - 175.5)^{1.5} + 2.7 \times 500 \times (H - 182.7)^{1.5} \\
 & + 2.7 \times 166 (H - 183.0)^{1.5}
 \end{aligned}$$

PRC Harris, Inc.

CONSULTING ENGINEERS

SUBJECT N. J. Dam Inspection SHEET NO. 6  
Pompton Dam JOB NO. 10-1176-61  
COMPUTED BY S. B. CHECKED BY DATE March, 1981

W. S. El	Stillway Head Hs	Qs	Head in Left Dam HL	QL	Head in Right Dam HR	QD	Q
①	②	③	④	⑤	⑥	⑦	⑧
175.5	0	0				0	
176	.5						
177	1.5	1587				1587	
179	3.5	5657				5657	
181	5.5	11,144				11,144	
182.7	7.2	16,692	0	—		16,692	
183	7.5	17,746	0.3	222	0	—	17,968
185	9.5	25,299	2.3	4,709	2	1267	31,275
187	11.5	33,695	4.3	12,038	4	3584	49,317
190	14.5	47,705	7.3	26,627	7	8297	82,629
195	19.5	74,379	12.3	58,236	12	18,623	151,258

K+E SEMILOGARITHMIC 5 CYCLES X 10 DIVISIONS  
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6210

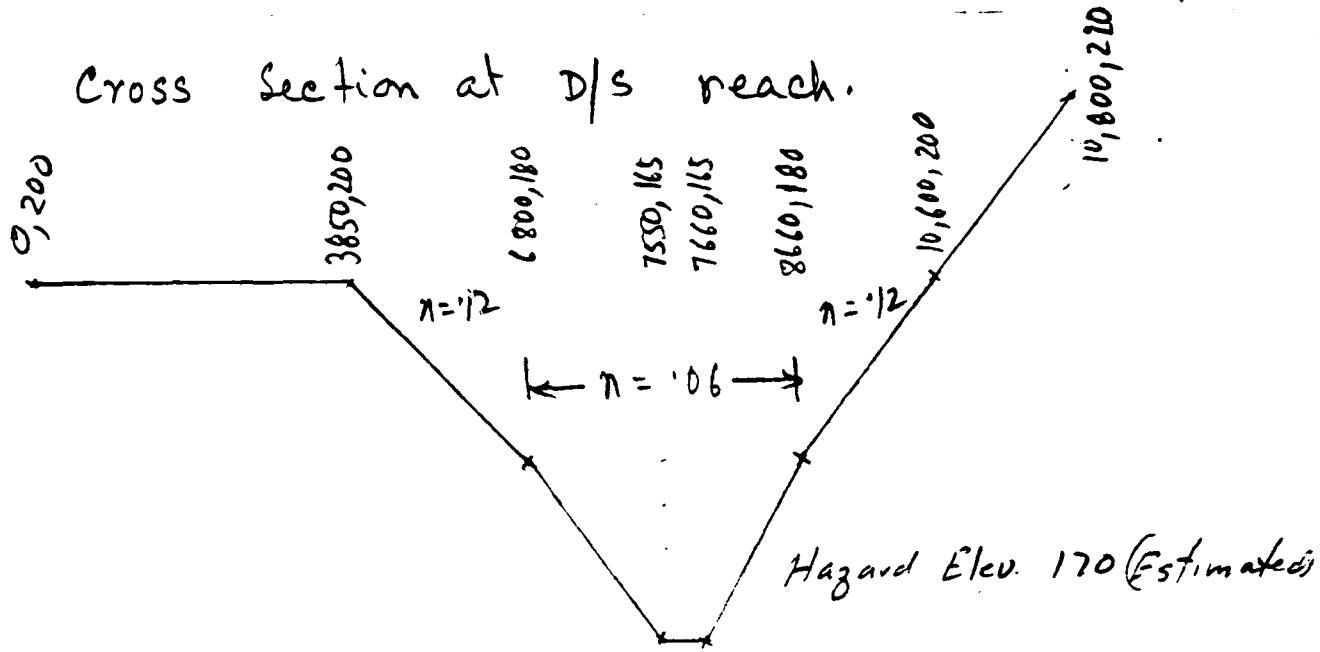
POMPTON DAM  
STAGE DISCHARGE

DISCHARGE

100,000  
10,000  
1000  
100

100 106 104 102 100 STAGE + 1 108 112 116 120

Cross Section at D/S reach.



REACH 1

$$L = 2000'$$

$$S = \frac{20}{30,000} = .000667$$

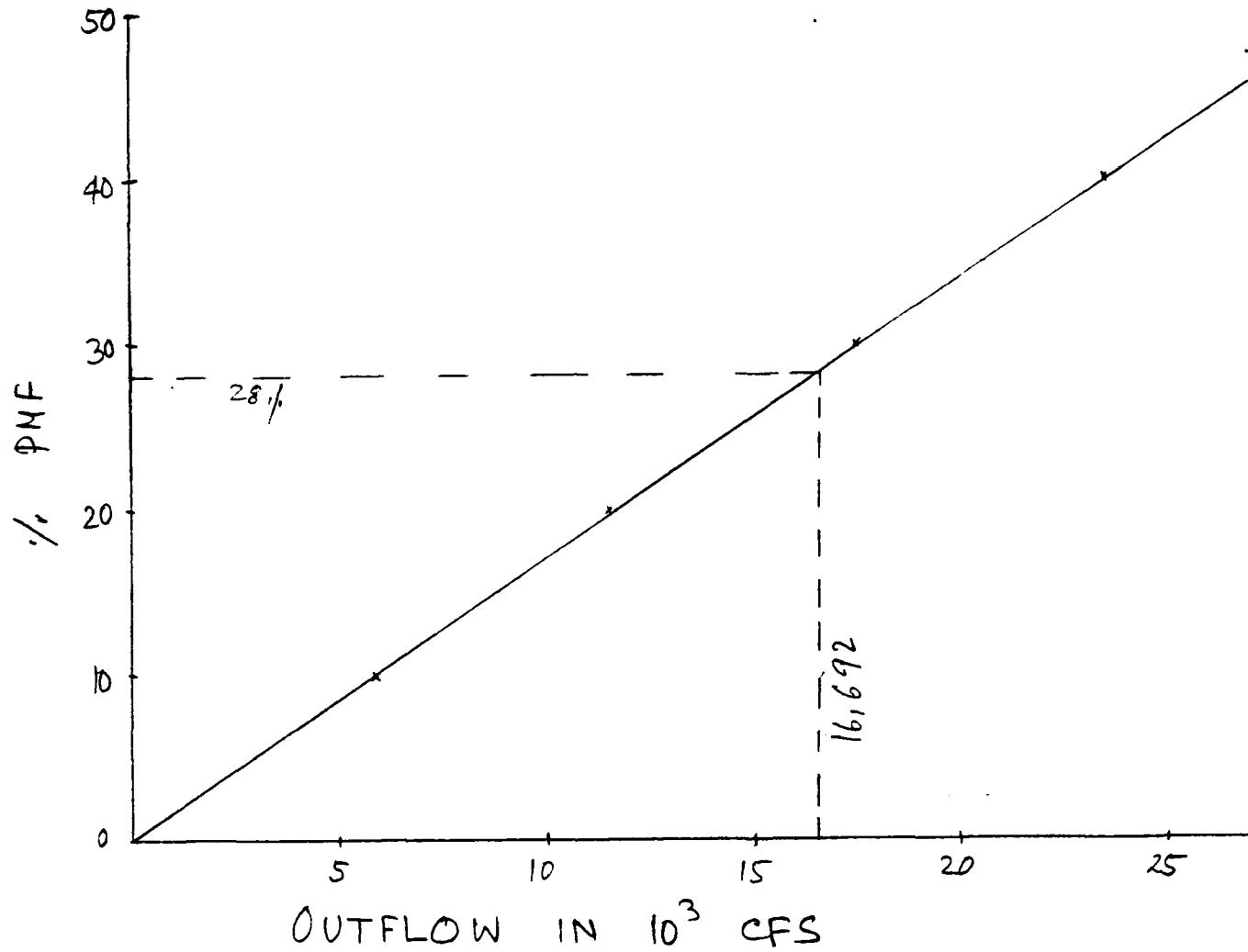
Section at Jackson Ave.  
Pompton Plains Cross Roads  
2000 ft D/S of Dam.

FREDERIC R. HARRIS, INC.  
CONSULTING ENGINEERS

SUBJECT N. J. DAM Inspection  
Pompton Lake Dam  
COMPUTED BY S.B. CHECKED BY

SHEET NO. 9 of  
 JOB NO. 10-1176-51  
 DATE

## Overtopping Potential

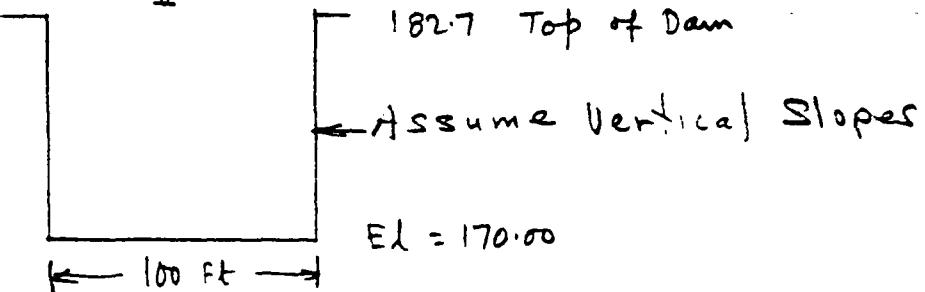


Overtopping of Dam will occur at  
28% of PMF, EL = 182.70,  $Q = 16,692 \text{ cfs}$

## Breach Analysis

Assume breach begins to develop when reservoir stage reaches above the Dam.

Time of Failure / hour:



Effect of breach was analyzed at 2000 ft downstream of the Dam, at 30% PMF

Maximum stage without Dam break = 1760  
Maximum stage with Dam break = 177.1

There will be 1.1 ft increase in stage due to Dam break analysis.

Note:- In the multiple PMF analysis the time interval is 6 hrs.

In the Dam break analysis, 6 hr interval ordinates of 0.3 PMF inflow Hydrograph is picked up from 54 hrs to 78 hrs. During that period overtopping of dam occurs. The ordinates are plotted and then interpolated at 1 hr interval for dam break analysis.



Relative Risk	0.50	0.40	0.30	0.20	0.10
Number of patients	100	100	100	100	100







卷之三

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HYDROLOGISCHE HALO

1. *U. S. Fish Commission, 1881, p. 100.* 2. *U. S. Fish Commission, 1881, p. 100.*

1. *CHARTER* 1688-1714

COMMUNISM 21

106. 12938. 13970. 15002. 16034

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17. 71 minutes = 1 hr 51 min

1/142. 16743. 14251. 13581.

4007. 4/4. 404. 388. 120

19.5.6 83.61 83.61

10141. 34809. 16857.

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16

Time (hrs.)	STATION - UNIT			(a) INTERPOLATED STREAM HYDROGRAPH			(b) COMPUTED STREAM HYDROGRAPH			(c) FLOODS AT FLOOD LINE INTERVAL		
	17000.	18000.	19000.	20000.	21000.	22000.	23000.	24000.	25000.	0.	0.	0.
12.00	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
12.02	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
12.04	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
12.06	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
12.08	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
12.10	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
12.12	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
12.14	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
12.16	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
12.18	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
12.20	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
12.22	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.24	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
12.26	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
12.28	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
12.30	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
12.32	17.	17.	17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
12.34	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
12.36	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.	19.
12.38	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.
12.40	21.	21.	21.	21.	21.	21.	21.	21.	21.	21.	21.	21.
12.42	22.	22.	22.	22.	22.	22.	22.	22.	22.	22.	22.	22.
12.44	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.	23.
12.46	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.	24.
12.48	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.

FLIGHT HYDROGRAPH PACKAGE (HGP-1)  
UWAN SAFETY VERSION JULY 1978  
LAST MODIFICATION 26 FEB 1979  
KELI U

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